Conclusion.

I do not feel justified in attempting to draw any general conclusions as to the relations of the various divergences from the common type that I have described; but I think that I have brought together enough matter to show that when a much larger number of facts has been collected, the method of investigation I have been following may furnish another clue to that riddle of zoology, the classification of birds. But in addition to this systematic interest, the comparative anatomy of a group of creatures so large in numbers and so alike in anatomical structure offers a field for the investigation of the innumerable divergences and convergences that have taken place in the evolution of the group. I cannot see that interpretations of isolated characters have any value. When we know the comparative anatomy of the greater number of characters that make up an animal, and not only those that seem to distinguish it as a species, the time may come for interpretation. But to those who care for discussions concerning isolated characters, I may suggest the problem: in these loopings of the gut in birds, there is an almost kaleidoscopic variety, and apparently these varieties are of systematic value; what are their utilities?

4. Myology of Rodents.—Part II. An Account of the Myology of the Myomorpha, together with a Comparison of the Muscles of the various Suborders of Rodents. By F. G. Parsons, F.R.C.S., F.Z.S., F.L.S., Lecturer on Comparative Anatomy at St. Thomas's Hospital.

[Received December 14, 1895.]

The present paper is intended to be a second instalment to the one "On the Myology of the Sciuromorphine and Hystricomorphine Rodents," which I had the honour of reading before this Society in 1894 (see P. Z. S. 1894, p. 251). I am again indebted to the kindness of the Society's Prosector, Mr. F. E. Beddard, for a large proportion of my material; indeed, it was his suggestion that a detailed examination of the muscles of Rodents would be of practical value in the Dissecting-Room at the Gardens that determined me to undertake the work in the first instance.

The first part of this paper contains an account of the muscles of thirteen Myomorphine Rodents, and as a statement of actual facts will, I hope, prove of some value.

The second part is devoted to a series of summaries and generalizations founded upon the facts with which these and previous dissections have furnished me. This part I regard as of less value than the first, because future dissections may make many alterations necessary. It seems well, however, to take stock of the mass of material from time to time as it accumulates.

The following is a list of the animals dissected for the first part of the present paper:—

Myoxus dryas.
Gerbillus shawi.
Cricetus frumentarius.
Cricetomys gambianus.
Microtus amphibius.
Myodes lemmus.
Mus decumanus.
Mus rattus.
Mus barbarus.
Rhyzomys badius.
Georychus capensis.
Bathyergus maritimus.
Heteromys longicaudatus.

Also

Lepus timidus and *Lepus cuniculus*

for the sake of comparison.

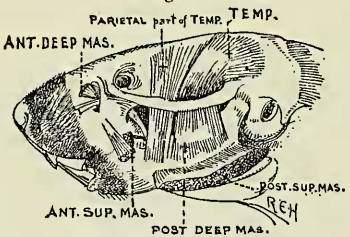
Accounts of the muscles of other animals by various authors have been used and their sources acknowledged in the text.

Muscles of the Head and Neck.

Temporal.—In all the Myomorpha the three parts of the temporal are more closely fused than they are in the Sciuromorpha, in this respect resembling the Hystricomorphine arrangement.

In the Water-Vole the parietal part of the muscle is very large and arises from the temporal fascia, as well as the parietal, maxillary, and frontal bones. It runs down as a flat tendon to be inserted, opposite the anterior molar teeth, into the mandible. The anterior deep part of the masseter, after coming through the infraorbital foramen, joins this tendon.

Fig. 1.



Masticatory muscles of Vole.

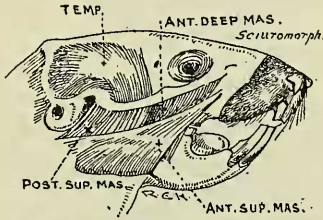
In the Myoxidæ and Muridæ the muscles of opposite sides are separated by an interval which is often, as in *Mus rattus*, of considerable extent. In the Spalacidæ, on the other hand, the two muscles rise close together, and the superficial layer described by Allen [1] is distinct and rises by aponeurosis from the sagittal crest. These animals, moreover, bear out the statement in Broun's

[1] Pr. Acad. Nat. Sc. of Philadelphia, vol. iii. p. 385.

'Thierreich,' that the size of the temporal varies inversely with that of the eyes, for in them the eye is rudimentary while the muscle is very large (*Rhizomys*, *Georychus*, *Bathyergus*).

Masseter.—The four parts of the muscle already described are present in the Myomorpha, but the posterior superficial and posterior deep parts are usually difficult to separate satisfactorily. The anterior superficial portion is constant and rises in front of the infraorbital foramen, from the side of the maxilla, by a narrow tendon. It is very strongly marked in the Spalacidæ, in which the lower jaw has a broad pulley-like groove under which the muscle passes to be inserted into the inner surface of the bone; this arrangement is very well seen in *Georychus* and *Bathyergus*. The anterior deep part shows an intermediate arrangement between the Sciuromorphine and Hystricomorphine type and throws a

Fig. 2.



Superficial dissection of Hamster's masseter.

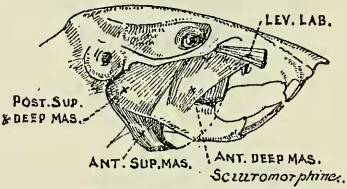
good deal of light on the morphology of this portion. In the Hystricomorpha there is a large infraorbital foramen through which the anterior deep part of the masseter passes to be inserted by a narrow flat tendon into the mandible opposite, or just in front of, the anterior cheek-teeth. In the Sciuromorpha the part which I have hitherto described as "anterior deep" rises from a vertical groove in front of the zygoma, and passes down to the same insertion without traversing any bony canal, the infraorbital foramen being only large enough to allow the passage of the nerve. As the insertion of a muscle is justly regarded as of more importance than the origin in determining homologies, I have hitherto looked upon these two portions as homologous, but the arrangement in many of the Myomorpha has made me change this opinion. In the Myomorpha the infraorbital foramen is intermediate between the arrangement found in the other two suborders; it is usually present as a vertical slit, through which passes a small bundle of muscular fibres corresponding to the anterior deep part of the Hystricomorphine masseter; but in addition to this there is another slip, corresponding to the Sciuromorphine anterior deep part, which rises in front of the zygoma

and runs down to be inserted, also by a narrow flat tendon, just external to the former and covering its insertion. This part is especially well marked in *Heteromys*. This arrangement, which is present in all the genera of the Muridæ that I have dissected, shows that, as the two muscles coexist in the same animal, they cannot be homologous, and I am now of opinion that the so-called

Fig. 3.

Deep dissection of Hamster's masseter.

Fig. 4.



Masseter of *Heteromys*.

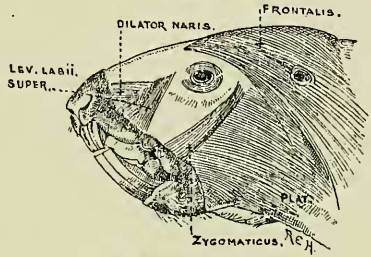
anterior deep part of the Sciuromorphine masseter is an extension forward of the posterior superficial plane of fibres. The arrangement in the Spalacidæ gives a clue to the way in which the infraorbital slip appears; in these animals it is very feebly marked, rises from the margins of the infraorbital foramen, and runs back to blend with the temporal instead of having an independent insertion opposite the anterior cheek-teeth.

Facial Muscles.—These muscles are best developed in the Spalacidæ, especially in *Bathyergus*. In this animal the frontalis is continuous dorsally and laterally with the superficial panniculus, and the muscles of the small auricle are extensions from this. The orbicularis palpebrarum in *Bathyergus* is very small, corresponding to the feeble development of the eye. The levator labii superioris corresponds with the description of it in the other Rodents[1]. The dilatator naris rises deep to this and passes to the

[1] P. Z. S. 1894, p. 253.

side of the nasal aperture. The zygomaticus rises behind and below the eye and runs to the angle of the mouth. The orbicularis oris is feeble, as the mouth never closes over the enormous lower incisors, and the infra-labial muscles are hardly developed at all.

Fig. 5.



Face-muscles of *Bathyergus*.

This description applies to the other animals examined, with the exception that a depressor labii inferioris can be made out, and that the orbicularis palpebrarum is better developed than in the Spalacidæ. The other facial muscles, especially the zygomaticus, are more difficult to separate from the facial panniculus. Windle, however, made out a levator alæ nasi, a dilatator naris, and a levator labii inferioris in *Hydromys chrysogaster*[1].

Buccinator.—The buccinator has the normal arrangement, except in *Cricetomys* and *Cricetus*: in the former animal I was unfortunately unable to examine the face owing to its damaged condition; in the latter the muscle is prolonged into a pouch which runs back along the side of the neck as far as the scapula, at its blind extremity a muscular fasciculus is attached to it, which runs backward to the posterior thoracic spines parallel to the posterior border of the trapezius, of which it seems a part, as it is supplied by a continuation of the spinal accessory nerve coming out of the trapezius. The action of this muscle would be to draw back the pouch and possibly to assist in emptying it.

Pterygoids.—The description of these muscles already given applies to the arrangement in the Myomorpha. In the Spalacidæ, especially in *Bathyergus*, the large anterior superficial part of the masseter is inserted into the inner surface of the mandible above the insertion of the internal pterygoid, so that the latter seems to stand out in a more isolated manner than is usually the case.

Digastric.—Distinct Hystricomorphine and Sciuromorphine types of this muscle have already been described. In the Myomorpha the type is usually Sciuromorphine, but certain

[1] P. Z. S. 1887, p. 54.

animals approach more or less closely to the Hystricomorphine arrangement.

In *Myoxus* the type is essentially Sciuromorphine, there is a distinct central tendon and a tendinous arcade connecting the anterior bellies of opposite sides; the two anterior bellies, moreover, are in contact in the middle line. The same arrangement is found in *Gerbillus* (where, however, the posterior bellies rise from the bulla tympani), in *Cricetomys*, in the Murinæ (*Mus rattus*, *M. decumanus*, and *M. barbarus*), and in *Rhizomys* among the Spalacidæ. In *Cricetus*, *Microtus*, *Myodes*, and *Hydromys* (Windle) the central tendon is reduced to a mere tendinous intersection as in the Hystricomorpha, but the two anterior bellies are still in close contact. In *Bathyergus* and *Georychus* among the Spalacidæ a similar arrangement is found, but, as in all other cases, the double nerve-supply of the muscle is preserved. *Heteromys* approaches most nearly to the Hystricomorphine type, since the two anterior bellies are not in contact and there is no tendinous arcade; there is, however, a distinct constriction and tendon between the anterior and posterior bellies.

Transverse Mandibular Muscle.—This muscle is present in all cases; it is perhaps better developed in the Muridæ than in the other families. When the mylo-hyoid comes far enough forward the transverse mandibular is superficial to it.

Mylo-hyoid.—The mylo-hyoid is attached posteriorly to the tendinous arcade connecting the digastrics and to the hyoid bone. Anteriorly the two muscles usually form a V-shaped border, with the aperture of the V forward, and do not reach the symphysis. In *Myoxus*, *Microtus*, the Murinæ (*M. rattus*, *decumanus*, and *barbarus*), and in *Heteromys* the muscle extends farther forward than in the rest and is then deep to the transverse mandibular.

Genio-hyoid.—The two muscles of opposite sides tend to coalesce posteriorly as in the Sciuromorpha.

Genio-hyo-glossus.—This has the usual attachments; it is specially large in *Rhizomys*.

Styloid Muscles.—The stylo-hyoid has the usual Rodent arrangement in passing deep to the digastric.

In *Rhizomys* these two muscles are closely blended, while in *Georychus* the blending seems to be more complete, for no distinct stylo-hyoid could be made out. The stylo-glossus rises by tendon from the posterior part of the bulla; it is very well marked in *Cricetomys*, while in *Georychus* and *Bathyergus* it rises by tendon from the stylo-hyal element of the hyoid arch. As in other rodents the stylo-pharyngeus was not seen as a distinct muscle.

Sterno- and Cleido-mastoid.—In the Myomorpha these two muscles are perhaps not quite so distinctly separated one from another as in either of the other suborders.

In *Cricetus*, *Myoxus*, *Microtus*, *Myodes*, *Mus barbarus*, *M. rattus*, and *Heteromys* the cleido-mastoid rises from the inner part of the bony clavicle under cover of the clavicular insertion of the trapezius; it is inserted into the curved line of the occipital bone, close to the

paroccipital process, by fleshy fibres. The sterno-mastoid has the usual origin and is inserted by tendon into the base of the paroccipital process in front of the last muscle; it is the larger muscle of the two. In *Cricetomys* the cleido-mastoid is not covered by the trapezius at its origin, it is, however, overlapped by the sterno-mastoid at its insertion. In the Gerbille the two muscles are continuous at their origin, the cleido-mastoid being the larger and rising from the inner half of the clavicle. *Rhizomys* resembles *Cricetus*, *Myoxus*, and the *Murinæ* in the origin of the cleido-mastoid being overlapped by the trapezius, and *Cricetomys* in the insertion being overlapped by the sterno-mastoid. In *Hydromys* [1] the cleido-mastoid is the smaller muscle and is overlapped at its insertion by the sterno-mastoid. In *Georychus* and *Bathyergus* the cleido-mastoid is not overlapped by the trapezius; in the latter the two muscles tend to fuse as in the Gerbille, but to a greater extent; at their insertion they are completely fused and are attached by a narrow tendon to the base of the paroccipital process.

Sterno-hyoid and thyroid.—In most cases these muscles have the human attachments. In *Bathyergus*, however, the sterno-hyoid misses the hyoid bone and continues on to the symphysis menti, in this respect somewhat resembling the arrangement found in *Myopotamus* [2]. In *Hydromys* the arrangement seems identical with that of *Myopotamus* [3].

Omo-hyoid.—As in the Sciuromorpha the omo-hyoid is always present in the Myomorpha; it has the same attachments, never, as far as I have seen, being attached to the clavicle. There is no central tendon. In *Bathyergus* the muscle is not attached to the hyoid bone, but is continued forwards with the sterno-hyoid to the symphysis menti.

Levator Claviculæ (*Acromio-trachelian*).—In all the animals examined this muscle rose from the anterior arch and transverse process of the atlas. Its usual insertion is into the acromial process, but sometimes it extends to the spine of the scapula. This description applies also to *Hydromys* [3]. In *Bathyergus* the muscle is very large and extends from the acromion on to the outer half of the clavicle at its insertion, in this respect resembling the Dipodidæ.

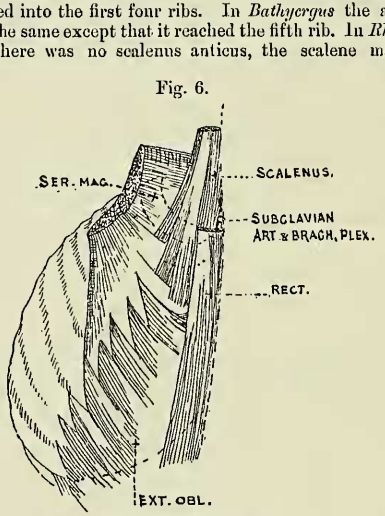
Rectus Capitis Anticus Major and Minor and Longus Colli.—These muscles have the Hystricomorphine attachments.

Scalene Muscles.—A scalenus anticus, that is a muscle passing to the first rib in front of the subclavian artery and brachial plexus, was only seen in the following animals—*Gerbillus*, *Georychus*, and *Bathyergus*. In these it resembled the same muscle among the Hystricomorpha, in rising from the basioccipital bone. The scalenus medius and posticus of human anatomy are represented by one mass, which rises from the transverse processes of all the cervical vertebræ, passes behind the brachial plexus, and is inserted into

[1] P. Z. S. 1887, p. 55.
[2] P. Z. S. 1894, p. 256.
[3] P. Z. S. 1887, p. 55.

the first four or five ribs. In *Cricetomys*, *Gerbillus*, *Microtus*, *Mus rattus*, *Myodes*, and *Heteromys* the muscle rose from all the cervical vertebræ and was inserted into the first five ribs. In *Myoxus* and *Cricetus* it was only inserted into the first four ribs. In *Georychus* the muscle came from the anterior four cervical vertebræ and was inserted into the first four ribs. In *Bathyergus* the arrangement was the same except that it reached the fifth rib. In *Rhizomys*, although there was no scalenus anticus, the scalene mass was

Fig. 6.



Scalene muscles of *Rhizomys*.

divisible into an anterior and a posterior part: the anterior part rose from the second to the seventh cervical transverse processes and was inserted into the first rib, while the posterior part only came from the transverse process of the atlas and went to the first four ribs.

Muscles of the Anterior Extremity.

The Pectoral Muscles.—For purposes of description, and for comparison with other Rodents, the same four divisions of the pectoral mass which have already been defined [1] will be here adhered to. The chief differences noticed in the Myomorpha are that α is not so oblique a muscle, and, as its fibres correspond in direction with those of β, the two parts are much less easily distinguished from one another. In *Cricetomys*, with which *Myoxus* closely agrees, α rises from the anterior part of the sternum and runs horizontally outward to be inserted into the pectoral ridge;

[1] P. Z. S. 1894, p. 259.

β rises from the whole length of the sternum; γ (the abdominal fibres) are feebly marked; δ (the part corresponding to the pectoralis minor) comes from the lower true rib-cartilages and runs forward and outward to the head of the humerus and to the coracoid process. *Heteromys* only differs from this description in having the abdominal fibres more closely united with the panniculus than in any other animal. In the Gerbille, α and β are fused, while γ and δ unite near their insertion, which is into the capsule of the shoulder and into the humerus just internal to the pectoral ridge. The Hamster differs from the last only in having the abdominal fibres better developed and running quite separately to the coracoid process. The Vole closely resembles the Gerbille, but is remarkable for the great development of the fibres from the cartilages (δ); these fibres unite with γ, and are inserted into the coracoid.

In the Rat and Mouse the arrangement is almost identical with that of the Gerbille.

In *Siphneus* Milne-Edwards describes a large and distinct pectoralis minor inserted into the coracoid process and coming from the second rib; this is interesting when one notices the similar arrangement in the Vole, an animal to which he regards *Siphneus* as being more closely related than to the Mole-Rats [1].

Rhizomys resembles *Cricetomys* except that δ is larger, rises from the 2nd to the 7th costal cartilages, and is inserted into the clavicle as well as the head of the humerus. *Georychus* has α and β fused; γ is inserted into the neck of the humerus; δ rises from the 2nd, 3rd, and 4th costal cartilages and is inserted into the coracoid and shoulder-joint.

In *Bathyergus* the pectoral mass is very large, and resembles the last in having α and β fused; but near the insertion the posterior fibres become tucked under the anterior and are inserted deep to them into the pectoral ridge. The abdominal fibres (γ) rise from the end of the sternum to the middle of the linea alba; they are inserted together with a large part of the latissimus dorsi into the capsule of the shoulder. The pectoralis minor (δ) rises from the posterior two-thirds of the sternum and the posterior true rib-cartilages, and is inserted into the outer half of the clavicle, having its anterior border in contact with the posterior border of the subclavius; between these two contiguous borders the external anterior thoracic nerve emerges to reach the superficial parts of the muscle.

Sterno-scapularis.—In the greater number of the Myomorpha this muscle is only represented, as in Man, by the subclavius, which rises from the cartilage of the first rib and is inserted into the outer half of the posterior border of the clavicle. *Georychus* and *Bathyergus* are the only exceptions which I have met with; in these there is a large and distinct claviculo-scapularis, as in the Hystricomorpha. In *Siphneus*, according to Milne-Edwards, the arrangement is the same.

[1] 'Recherches des Mammifères,' tome i. p. 99.

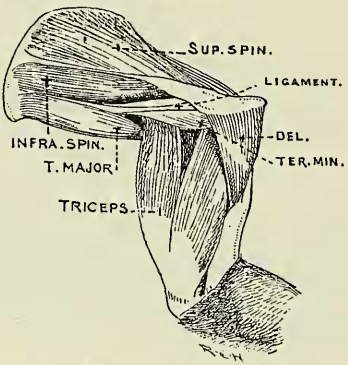
Deltoid.—This muscle in the Myomorpha has the usual three parts, but the intervals between them are hardly noticeable; moreover, they are all inserted into the humerus at the same point. The portion rising from the spine of the scapula, instead of being the smallest, as in the Hystricomorpha, is usually the largest. This description applies to all the animals examined, with the exception that in *Bathyergus*, *Georychus*, and *Siphneus* the intervals are so ill-marked that the muscle appears single as in Man.

Supraspinatus, Infraspinatus, and Subscapularis.—These resemble the same muscles in the other Rodents in having the human attachments. In some, e. g. *Cricetomys*, the supraspinatus is larger than the infraspinatus; but, as a rule, the reverse is the case. Milne-Edwards points out that in *Siphneus* the supraspinatus only occupies the anterior three-fourths of the fossa, the posterior part giving attachment to the rhomboid.

Teres Major.—This has the usual attachments, its relation to the tendon of the latissimus dorsi is variable, and depends on the extent to which that muscle is wrapped round the lower border of it. In *Myoxus*, *Cricetus*, *Rhizomys*, *Microtus*, *Mus barbarus*, and *M. rattus* the teres major is wrapped round by the latissimus dorsi, so that the latter is inserted anteriorly to it. In *Cricetomys*, *Georychus*, and *Bathyergus* the wrapping round is not so complete, and the teres major is inserted in front of the latissimus dorsi. In *Siphneus* the arrangement seems to be the same.

Teres Minor.—This muscle closely agrees with the description given of it in the other Rodents. It is very rarely a distinct muscle, *Cricetomys* being the only animal in which it could be described as well-marked. It is interesting to notice that a strong

Fig. 7.



Shoulder-muscles of *Rhizomys*.

ligament was seen in *Rhizomys* running from the axillary border of the scapula, between the origins of the teres major and minor, across the latter muscle to the metacromion process. A similar ligament has already been described in *Lagostomus*[1].

Biceps Cubiti.—There can be no doubt that, speaking generally, one of the characteristics of the Myomorpha is a double-headed biceps. This was noticed in every specimen which I dissected. Milne-Edwards, however, found only one head in *Siphneus*, but it is possible that further investigation may prove that this was merely an individual variation. In *Hydromys* Windle does not notice the condition of the biceps.

As a rule the insertion is into both bones of the forearm, but in *Cricetus* and *Myoxus* the muscle only goes to the radius, while in *Rhizomys* the ulna is the only bone to which it is attached. In *Georychus* and *Bathyergus* the two heads are easily separable down to the insertion by a little force. In the former the coracoid head goes entirely to the radius, the glenoid head to the radius and ulna; in the latter both heads can be traced to both bones.

Coraco-brachialis.—In the Myomorpha the most usual arrangement is to find the second and third parts, described by Wood[2], present; they are, however, fused, and the muscle has one continuous insertion from the middle of the humerus to the internal condyle. This description applies to *Rhizomys*, *Siphneus*, *Microtus*, *Myodes*, *Heteromys*, *Hydromys*, and the Murinæ. The Cricetinæ (*Cricetus* and *Cricetomys*) have the same arrangement, but in addition the first part or rotator humeri is present. In *Gerbillus* and *Myoxus* only the second part was seen.

In *Georychus* the muscle was absent, while in *Bathyergus* it was very small, and was only represented by the second part. Milne-Edwards says that the muscle is absent in "le Rat-Taupe du Cap," by which, I suppose, *Bathyergus* is meant. In all the animals dissected, as in other Rodents, the musculo-cutaneous nerve passes above the second part of the muscle.

Brachialis Anticus.—All the Myomorpha have the external and internal heads of the brachialis anticus, and these are more or less completely fused; perhaps *Bathyergus* shows them most clearly separated from one another. The insertion, in every case that I dissected, was into the ulna only, but Milne-Edwards describes an additional feeble attachment into the head of the radius in *Siphneus*.

Triceps and Anconeus.—There is no difference between the Myomorphine triceps and that of other Rodents. In *Cricetomys* it was noticed that the outer head was inserted largely into the fascia of the outer side of the forearm. *Bathyergus* resembles *Castor* in the great development of the muscle, and in the fact that it is attached to both sides of the olecranon, as well as to the top. The anconeus has the usual attachments, and shows nothing of special interest.

[1] P. Z. S. 1894, p. 263.
[2] Journ. of Anat. vol. i. p. 45.

Epitrochleo-anconeus.—This is present in all the Myomorpha; it is supplied by the ulnar nerve.

Pronator Radii Teres.—This muscle agrees with the description given of it in other Rodents; in *Mus barbarus* and *Cricetus* it is inserted into the second quarter of the radius, while in all the other animals examined it goes into the middle of that bone. *Cricetomys* resembles *Sciurus* in possessing a supracondylar foramen, but in it the pronator teres does not rise from the supracondylar arch, as it does in *Sciurus*.

Flexor Carpi Radialis.—The attachments of this muscle were normal in all cases. In the Vole, and, to a lesser extent, in all Rodents, the tendon of this muscle is bound down to the flexor surface of the radius by a fibrous pulley just below the attachment of the pronator radii teres.

Palmaris Longus.—The muscle is present and large in *Cricetomys*, *Crictus*, *Microtus*, *Georychus*, *Bathyergus*, *Mus rattus*, *Siphneus*, and *Heteromys*; it is inserted into the palmar cartilage or ossicle and into the fascia of the palm. In *Rhizomys* and *Gerbillus* it is only inserted into the fascia, while in *Myoxus* it is absent. In *Mus barbarus* it is developed as a slip from the surface of the flexor sublimis digitorum, an arrangement which recalls that found in *Cœlogenys* and *Xerus*.

Flexor Sublimis Digitorum.—In all the animals examined, except *Myoxus*, this muscle rises from the internal condyle and forms the flexor perforatus for the 2nd, 3rd, and 4th digits. In *Myoxus* it also goes to the 5th digit. Milne-Edwards describes the slip to the 2nd digit as a distinct muscle in *Siphneus*.

Flexor Carpi Ulnaris.—This muscle has the usual attachments, except that in *Rhizomys* and *Bathyergus* the origin from the internal condyle is wanting. The tendon is specially thick in *Georychus*.

Flexor Profundus Digitorum.—The deep flexor of the fingers is composed, as in other Rodents, of two superficial heads from the internal condyle and of two deep heads from the flexor surfaces of the radius and ulna. A small slip is given off to the pollex from the front of the tendon formed by these heads in *Cricetomys*, *Gerbillus*, *Microtus*, *Mus barbarus* and *rattus*, *Myodes*, *Georychus*, *Bathyergus*, and *Rhizomys*. In *Myoxus*, *Cricetus*, and *Siphneus* (Milne-Edwards) no tendon goes to the thumb. In *Bathyergus* the fibres derived from the different heads were traced downward through the tendon, and it was found that the two condylar heads join together to form the superficial part of the tendon, which gradually winds round the outer side to eventually become deep. When the tendon divides into its ultimate five slips for the four fingers and the thumb, each slip receives fibres both from the condylar and the radio-ulnar origins. This twisting of the tendon reminds one of the arrangement of the fibres of the tendo Achillis[1]. There are usually four lumbricals which arise from the flexor surface of the tendon at or before its point of division.

[1] Author's paper, 'Journ. Anat.' vol. xxvii. p. 414.

In *Microtus*, *Rhizomys*, *Bathyergus*, and *Hydromys*, however, only three lumbricals were seen, the radial one having been suppressed.

Pronator Quadratus.—This muscle is less well developed as a rule than in the Hystricomorpha, never, so far as I have seen, extending along the length of the bones. In *Myoxus* and *Microtus* it occupies the middle third of the forearm; in *Cricetomys*, *Cricetus*, and *Mus barbarus* the lower half. In the Gerbille it attains its maximum of development, and is attached to the lower three-quarters of the two bones. In *Georychus*, *Bathyergus*, *Rhizomys*, and *Siphneus* it is a very feeble muscle—in the two former being found only opposite the insertion of the pronator radii teres, while in the two latter it is represented by a few fibres between the lower ends of the two bones.

Supinator Longus.—This muscle was wanting in every animal dissected. Windle found it absent in *Hydromys*, and Milne-Edwards says that it is also wanting in *Siphneus*, *Spalax*, and *Helamys*. He states, however, that it is present in the Hamster, and, although it was most certainly absent in the Hamster I dissected, I take his statement to mean that very occasionally a supinator longus may be found among the Myomorpha as a reversion to the Sciuromorphine type.

Extensor Carpi Radialis Longior and Brevior.—In all the animals examined these muscles had the usual attachments. When there is any difference in size, as in the case of *Myoxus*, *Georychus*, *Rhizomys*, and *Siphneus*, the brevior is the larger muscle. Milne-Edwards says that in *Georychus* and *Spalax* there is only one radial extensor, but he does not mention where that one is inserted. Unless the insertion is carefully looked for the two muscles may easily be mistaken for one, as they lie very close to one another.

Extensor Communis Digitorum.—The only point of interest in the Myomorphine common extensor is whether it goes to the fifth digit or not. In *Georychus*, *Bathyergus*, *Siphneus*, and *Mus barbarus* no slip is given to the little finger. In *Cricetomys* two tendons pass to the middle, and in *Rhizomys* two to the ring finger.

Extensor Minimi Digiti.—The insertion of this muscle was into the fourth and fifth fingers in *Gerbillus*, *Microtus*, *Myodes*, *Mus barbarus*, *Hydromys*, *Georychus*, *Bathyergus*, and *Rhizomys*. In *Bathyergus*, however, the tendon to the fourth digit was very small. In *Cricetus* it was attached to the third and fifth digits, while in *Myoxus* and *Cricetomys* it only went to the fifth.

Extensor Carpi Ulnaris.—Nothing special was noticed in the attachments of this muscle. Milne-Edwards describes it as a double muscle in *Siphneus*, one tendon going to the base of the fourth, and the other to the base of the fifth metacarpal bone, at the same time he does not describe any extensor minimi digiti. Considering the very constant character of the extensor carpi ulnaris in Rodents, and the comparative inconstancy of the extensor minimi digiti, I expect that the explanation of what he

found is that the outer division of his extensor carpi ulnaris is really the extensor minimi digiti, the tendon of which has lost its digital attachments and has become inserted into the base of the fourth metacarpal bone.

Supinator Brevis.—The description of this muscle given in the other Rodents applies to the Myomorpha, with the exception that in the latter a sesamoid bone is usually found in the tendon. The only animals in which this bone was wanting were *Bathyergus* and *Georychus*. The relationship of the tendon of the supinator brevis to the external lateral ligament of the elbow is interesting, in some cases, as in that of *Bathyergus*, there is a well-marked external lateral ligament, situated behind the tendon, but in others, of which *Cricetomys* is an example, the tendon itself seems to form the lateral ligament, and has the orbicular ligament attached to it.

Extensor Ossis Metacarpi Pollicis.—In all cases this muscle rises from both bones, and is inserted into the base of the metacarpal bone. In the Gerbille its tendon was double. In *Cricetus* and *Cricetomys* it had an extra insertion into the radial sesamoid bone or palmar cartilage.

Extensor Primi Internodii Pollicis.—In every animal examined this was absent.

Extensor Secundi Internodii Pollicis.—This muscle was only seen in *Georychus*, where it was well-marked, it accompanied the extensor indicis and separated on the back of the hand. This arrangement is practically the same as that already described in *Castor*.

Extensor Indicis.—As in other Rodents the extensor indicis rises from about the middle of the back of the ulna, and is inserted only into the dorsal side of the index. In *Myoxus* it rises from the top of the back of the ulna close to the olecranon. In the Vole I dissected the tendon had acquired a secondary attachment to the prominent ridge on the back of the radius at its lower end, while the part of the tendon between this and the index was wanting.

Palmaris Brevis.—When a palmar ossicle is present, which is not so often the case as in other Rodents, the muscle is attached to it. When there is no ossicle it is attached to the palmar fascia. In *Microtus* and *Bathyergus* no palmaris brevis was found.

Flexor Brevis Digitorum Manus.—This muscle was found in *Cricetomys*, *Cricetus*, *Georychus*, and *Bathyergus*. In the first three it arose from the palmar ossicle, but in the last from the fascia just external to the pisiform bone.

Muscles of the Thumb.—In almost all cases the abductor pollicis can be made out, and has its origin from the palmar ossicle. The flexor brevis was made out with difficulty in *Myoxus*, *Georychus*, and *Bathyergus*; in the two latter the thumb is provided with a pair of sesamoid bones, as in all the other fingers. *Bathyergus* has a prominent cartilaginous spur on the outer and inner side of the hand; these probably represent the prepollex and postminimus.

In no case could I satisfy myself of the existence of an adductor or opponens pollicis.

Muscles of the Little Finger.—These are not so easily made out as in the other Rodents. The abductor is present, but is not double. The flexor brevis is represented by the ulnar slip of the interosseus muscle to the little finger, when there happens to be a muscle in that position. I have never been able to find an opponens, although Windle describes it in *Hydromys*.

Interossei.—In all the animals examined, except *Georychus* and *Bathyergus*, there were eight interossei, the inner of which formed the flexor brevis minimi digiti. In these two animals there were no interossei attached to the fifth finger, although the two sesamoid bones supposed to be developed in them were present. Practically the same arrangement was found in the Beaver. In *Cricetomys*, *Microtus*, and possibly in *Cricetus*, there was an adductor minimi digiti, which recalls the figure already published [1] of the same muscle in *Cœlogenys*. In *Rhizomys* and *Gerbillus* there is an adductor indicis. These two muscles are situated on a plane superficial to that of the interossei, and I have not come across any Myomorphine animal which possesses both of them, although they frequently co-exist in the Hystricomorpha.

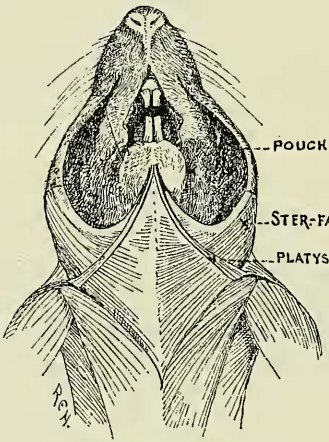
Muscles of the Trunk.

Panniculus Carnosus.—In the majority of the Myomorpha the panniculus corresponds to the rodent type already described. The sterno-facialis is always present, but seldom large. In *Georychus* and *Bathyergus* the panniculus, especially the anterior part, is very well developed; in the former the platysma is very strong and rises from the angle of the mouth and from the median raphe running back from the symphysis menti, it runs backward and upward to be lost over the region of the shoulders, though some of the more posterior fibres are attached to the metacromial process. When this is removed, the whole length of the sterno-facialis and epitrochleo-facialis comes into view, the former rising from the posterior half of the sternum, the latter from the internal condyle of the humerus; they both run forward to be inserted into the fascia on the surface of the masseter. In *Bathyergus* the sterno-facialis has undergone greater development, and is continuous posteriorly with the panniculus of the abdomen; this I have figured, and have pointed out [2] that it is a possible foreshadowing of the human sternalis muscle. The posterior part of the panniculus in *Bathyergus* is also well marked, and gets an attachment to the external tuberosity of the tibia and to the ramus of the ischium. In *Heteromys* among the Geomyidæ, the pouch causes a good deal of modification in the facial panniculus. The superficial part or platysma rises from the

[1] P. Z. S. 1894, p. 273.
[2] Journ. Anat. vol. xxix. p. xii.

surface of the pouch, and runs backward and upward under the ear to be lost on the back of the neck. When this is dissected away, there is seen to be a deeper layer of muscle having exactly the same direction, and also coming from the surface of the pouch. By far the larger portion of the outer wall of the pouch is formed by the sterno-facialis muscle, which is especially thick at the orifice forming a partial sphincter; the fibres of this muscle run downward and backward to be inserted into the anterior half of the sternum, superficial to the pectoralis major. There is no panniculus in the inner wall of the pouch, which consists solely of skin covering the masseter and buccinator muscles, with the

Fig. 8.

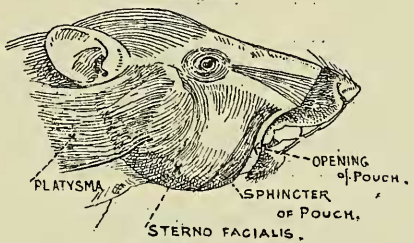


Pouch-muscles of *Heteromys*.

exception of one narrow slip which rises from the mental symphysis, runs round the inner side of the opening of the pouch, and when it reaches the lower margin turns sharply outward, superficial to the fibres of the sterno-facialis, to run to the side of the neck, where it joins the platysma. This decussation of the fibres guarding the outer and the inner side of the aperture gives a powerful sphincteric action by which the pouch can be closed at will. It is worth while to compare the anatomy of the pouch in the Geomyidæ with that in *Cricetus*, and to notice that, whereas in the former the pouch is formed by an invagination of skin probably perforating the platysma, so as to leave some of

that muscle on the inner side of the opening, while the pouch itself is deep to the whole of the panniculus, in the latter the

Fig. 9.



Pouch-muscles of *Heteromys*.

pouch is formed by an evagination of the buccinator, to the fundus of which a slip of platysma has become attached.

Latissimus Dorsi.—This muscle has the same attachments that it possesses in other Rodents; the dorso-epitrochlearis is always present, and reaches as far as the olecranon, though in *Cricetomys* it is also inserted into the fascia of the forearm.

Trapezius.—In most of the Myomorpha as in the Sciuromorpha there are three separate parts of the trapezius. The first of these, described by Milne-Edwards[1] and by Strauss-Dürckheim as the clavo-cucullaris, consists of the fibres passing between the occiput and the clavicle; it is separated from the rest of the muscle by the levator claviculæ, and was found in the following animals:—*Myoxus*, *Cricetus*, *Cricetomys*, *Microtus*, *Myodes*, *Mus decumanus*, *Heteromys*, *Bathyergus*, and *Siphneus*. In *Georychus* and *Mus barbarus*, however, this part of the muscle was not seen. The second part, or acromio-cucullaris, consists of the fibres running between the ligamentum nuchæ and the anterior thoracic spines on the one hand, and the acromial process and spine of the scapula on the other; it is usually separated from the third part or dorso-cucullaris by a pad of fat. In all the animals dissected, these two parts were separate with the exception of *Cricetomys* and *Myoxus*.

Rhomboidei.—The rhomboideus capitis is a distinct muscle, while the major and minor are not separable one from another. In *Cricetus*, *Myoxus*, *Microtus*, *Georychus*, *Bathyergus*, and *Heteromys*, part of the rhomboideus capitis rising from the outer part of the occipital curved line is separated from the rest and runs to the inner half of the spine of the scapula, covering part of the supra-spinatus instead of going to the vertebral border.

Serratus Magnus and Levator Anguli Scapulæ.—The origins of

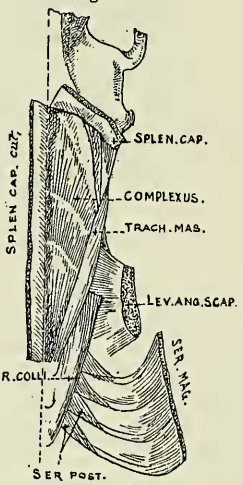
[1] 'Études pour servir, &c.,' p. 94.

these combined muscles in the various animals dissected are the following:—

Myoxus	2–7 c. v.	1–7 ribs.
Cricetus	3–7 „	1–7 „
Gerbillus	2–7 „	1–8 „
Microtus	2–7 „	1–8 „
Myodes	2–7 „	1–8 „
Mus barbarus	2–7 „	1–7 „
„ *rattus*	2–7 „	1–7 „
Rhizomys	1–7 „	1–8 „
Georychus	3–7 „	1–10 „
Bathyergus	3–7 „	1–10 „
Heteromys	2–7 „	1–8 „

Serratus Posticus.—In the Myomorpha the anterior part of this muscle is always present and well marked; it is usually inserted into the ribs from the 4th to the 7th, but in *Cricetomys* it is continued back to the 9th, and in *Rhizomys* to the 11th. In *Georychus* and *Bathyergus* it is inserted into the 6th, 7th, and 8th ribs. The posterior part of the serratus posticus was only seen in *Microtus*, *Bathyergus*, and *Myodes*; in the first it was inserted into the last 4, and in the two latter into the last 5 ribs.

Fig. 10.



Neck-muscles of Hamster.

Sacro-lumbalis and Longissimus Dorsi.—These muscles show nothing remarkable in their attachments.

Transversalis Capitis et Colli.—In *Myoxus* the trachelo-mastoid or transversalis capitis was absent, in all the other animals both muscles were found.

Splenius Capitis et Colli.—The splenius capitis rises from the ligamentum nuchæ nearly as far forward as the occiput, and almost entirely covers the complexus; it has the usual attachments. The splenius colli was not seen at all.

Complexus.—There is usually a slight tendency to longitudinal division, but this is not seen in *Georychus*, *Bathyergus*, *Myoxus*, or *Myodes*. *Cricetus* shows two intersections extending across the whole muscle, while in *Rhizomys* they only extend across the outer half of it.

Tail-Muscles.—In those animals which have tails, the arrangement of the muscles is the same as in other Rodents.

Obliquus Externus Abdominis.—This muscle usually rises from the posterior nine or ten ribs. The description already given of it in the other Rodents applies to the Myomorpha, with the exception that it never runs upward to the first rib with the rectus. The outer pillar of the abdominal ring is large and muscular, and is inserted into the whole length of the body of the pubes, external and parallel to the symphysis. The inner pillar is thin and fascial. In *Cricetomys* five or six lineæ transversæ were seen extending across the muscle from the rectus, while in *Microtus* the same thing was also noticed, but much less distinctly.

Obliquus Internus and Transversalis.—These muscles can be separated with great care. In *Bathyergus* they are very well marked, and in that animal the relation of the aponeurosis to the rectus can be made out, and is found to be as in Man. In *Mus rattus* the scrotal pouches are very large, and are composed entirely of the internal oblique.

Rectus Abdominis.—In all the specimens of the family of Muridæ examined there was a decussation resembling that already described in the Octodontidæ [1]; this was not seen in *Myoxus*, *Georychus*, or *Bathyergus*, though it was found in *Rhizomys*.

Supracostalis.—In no Rodent was this muscle seen.

Psoas Parvus.—The psoas parvus was present in all the specimens except the Gerbille; in *Microtus*, *Rhizomys*, and *Georychus*, however, it was small.

Psoas Magnus and Iliacus.—These muscles have the usual rodent attachments.

Quadratus Lumborum.—In most of the Myomorpha the quadratus lumborum does not seem to rise from as far forward in the dorsal region as it does in the other Rodents. It is attached to all the lumbar vertebræ except in the case of *Rhizomys*, where it only comes from the first three.

[1] P. Z. S. 1894, p. 280.

Muscles of Posterior Extremity.

Gluteus Maximus, Tensor Fasciæ Femoris, and Sartorius.—The description already given[1] applies perfectly to the Myomorpha; the tensor fasciæ and sartorius are, however, as a rule less well marked, and there is also a closer union between the posterior border of the gluteus maximus and the anterior border of the biceps femoris. The bony insertion of the gluteus maximus is into the middle of the femur except in *Cricetus*, where it is also attached to the external supra-condylar ridge of the femur, and in *Rhizomys*, where it is attached almost entirely to the third trochanter in the upper part of the bone. The sartorius and tensor fasciæ femoris are best marked in *Cricetus*, while in *Georychus* they are practically absent.

Gluteus Medius and Minimus.—These muscles present no differences from those already described in other Rodents.

Scansorius.—The scansorius is so closely fused with the gluteus minimus, that it is only possible to make it out as a distinct muscle in *Cricetomys*, though even there the separation is not very clear.

Pyriformis.—This muscle is also much more closely fused with the gluteus minimus than in the other Rodents; indeed, the Myomorpha are remarkable for the unsatisfactory differentiation of the muscles composing the gluteal mass.

Obturator Internus, Externus, and Gemelli.—These muscles correspond to their descriptions in the other Rodents. The anterior gemellus is always better marked than the posterior one.

Quadratus Femoris.—There is usually a very slight tendon at the insertion, the muscle being triangular as in the Hystricomorpha and differing from the quadrilateral Sciuromorphine type; it is always large and distinct.

Biceps Femoris.—In *Myoxus*, *Mus barbarus*, and *Mus rattus* the two parts of which the biceps is composed are closely united and have one continuous insertion, as is the case in the Hystricomorphine Rodents. In the other Myomorpha the two parts are easily separable, as they are in *Sphingurus*[2]. When this happens, it is the upper part which rises from the anterior caudal vertebræ and is inserted into the outer side of the patella and ligamentum patellæ, while the lower part rises from the tuber ischii and is inserted into the fascia on the outer side of the leg. In certain cases, e. g. *Cricetomys* and *Myodes*, the upper portion is very closely connected to the gluteus maximus; while in *Cricetus* it is so closely blended with that muscle, that it has already been described as a part of the gluteus maximus which is inserted above the external condyle of the femur.

In *Georychus*, *Bathyergus*, *Rhizomys*, and *Heteromys* the two parts are separate from one another and from the gluteal.

[1] P. Z. S. 1894, p. 282.
[2] P. Z. S. 1894, p. 284.

Semitendinosus.—The normal arrangement seems to be, as in the other Rodents, that one head should rise from the posterior sacral and anterior caudal vertebræ, while the other comes from the tuber ischii. Either of these heads is often wanting. In *Georychus*, *Bathyergus*, and *Mus barbarus* the head from the tuberosity alone was found, while in *Microtus* and *Heteromys* only the spinal head was present. With regard to the arrangement in *Mus barbarus*, it is interesting to note that *Mus rattus* has both heads. The insertion in all cases is the same as that described in the other Rodents.

Semimembranosus.—The two parts of this muscle are always present, and correspond to the description already given in other Rodents. The seminembranosus proper is quite constant, always rising from the tuber ischii and being inserted into the back of the internal tuberosity of the tibia. The supracondylar slip, as in the Hystricomorpha, is variable both in size and in origin; its insertion, however, above the internal condyle of the femur is quite constant. In *Gerbillus*, *Mus barbarus*, and *Mus rattus* the supra-condylar portion rises from the anterior caudal vertebræ. In *Cricetus* it is small and comes from the caudal vertebræ and the tuber. In the other animals examined it rises from the tuber ischii only in common with the rest of the semimembranosus except in the case of *Bathyergus*, where its origin is more in common with that of the semitendinosus from the tuber. This supra-condylar slip is largest in *Georychus*, where it is greater than the rest of the muscle; in *Bathyergus* it is not so large; in *Rhizomys* it is only half the size of the rest of the muscle; while in *Cricetus* it is quite small. In *Hydromys*, Windle says [1] that the semimembranosus is inserted into the condyle of the femur alone, that is to say, the main part of the muscle is wanting. His dissection must of course be repeated, to see whether he had chanced upon an individual variation or whether this arrangement is constant in *Hydromys*. The nerve-supply of the two parts of the semimembranosus is as in other Rodents.

Gracilis.—This muscle is usually double and the two parts have approximately the attachments described in the Hystricomorphine Rodents; the anterior muscle usually overlaps the posterior a good deal. In *Myoxus*, *Rhizomys*, and *Heteromys* no separation was seen. In *Georychus* and *Bathyergus* the separation was very marked, there being quite an interval near the insertion. In *Myodes* the interval is greatest at the origin. *Hydromys* according to Windle agrees with *Myoxus* and *Rhizomys*.

Pectineus.—This muscle corresponds to the account of it in the other Rodents. In *Gerbillus*, *Cricetus*, *Myoxus*, and *Rhizomys* the muscle is double, but I am inclined to regard the inner part as belonging to the adductor mass, possibly representing the adductor longus.

Quadriceps Extensor.—In all the animals dissected, the two heads of the rectus could be made out, though in *Rhizomys*, *Georychus*,

[1] P.Z.S. 1887, p. 57

and *Bathyergus* the straight head was reduced to a minimum; the reflected head has usually some fleshy fibres rising directly from it. With regard to the other muscles the vastus externus is large and separate, while the internus is small and closely blended with the crureus.

Adductors.—The adductor mass in the Myomorpha resembles in its complexity that of the Sciuromorpha, although one frequently finds attempts at the more simple arrangement of the Hystricomorpha by fusion or non-differentiation of contiguous parts. As in the other Rodents, the supracondylar slip has been described with the semimembranosus, to which it undoubtedly belongs. Perhaps the animal which shows the greatest differentiation is *Cricetomys*: in it the mass consists of the following parts:—(1) The most anterior portion from the ilio-pectineal line to the middle of the posterior border of the femur by a narrow flat tendon. (2) Deep to this is another bundle which has the same origin but comes from rather more of the symphysis and goes to the whole of the femur as low as the ligamentum patellæ. (3) Behind the last is a thin flat portion rising by tendon from the horizontal ramus and being inserted into the lower half of the femur. (4) Most posteriorly, there is a thick mass from the ramus and tuber ischii which is inserted into the whole length of the back of the femur from the insertion of the quadratus femoris to the internal condyle.

In *Cricetus* (1) and (2) are fused and (4) only goes to the upper half of the femur. In *Microtus* (1) and (2) are fused, as are also (3) and (4). In *Gerbillus*, *Mus barbarus*, and *Mus rattus* (3) was not identified, while (4) was only inserted into the upper half to two-thirds of the femur. *Rhizomys* closely resembles *Cricetomys*. In *Georychus* and *Bathyergus* (1) is inserted into the middle third of the femur behind the pectineus, while the other three parts are fused into one great mass, which in *Georychus* is inserted into the middle two-fourths of the back of the femur, while in *Bathyergus* it goes to the whole length of that bone. In *Hydromys*, according to Windle, the adductor magnus, which apparently corresponds to the part which I have described as (4), reaches as low as the head of the tibia [1].

Tibialis Anticus.—This muscle always has the humau origin; it never rises from the femur as in some of the Hystricomorpha. In *Georychus* the tibia above the cnemial crest is flattened, and forms a triangle with the apex downward and the surface a little concave; from this the muscle rises. As a rule, the tendon divides slightly below to be inserted into the internal cuneiform and the base of the first metatarsal, the latter insertion being the smaller.

In *Microtus*, however, the tendon divides into two equal parts. In *Gerbillus*, *Mus barbarus*, *Mus rattus*, and *Myodes* the tendon does not divide at all, but goes entirely to the cuneiform. In *Heteromys* the division is well marked, but both parts are inserted into the cunêiform.

[1] P. Z. S. 1887, p. 58.

Extensor Longus Digitorum.—As in all other Rodents, this muscle rises by tendon from the front of the external condyle of the femur. In *Mus barbarus*, however, as in *Sphingurus* and *Dipus*, a few accessory fibres came from the head of the tibia. The insertion is into the second, third, fourth, and fifth toes except in *Mus barbarus*, where the slip to the little toe was wanting, and in *Gerbillus*, where there was in addition a feeble slip to the first toe.

Extensor Proprius Hallucis.—This is always present and has the normal insertion. Its exact origin varies a good deal, and apparently is of little importance from a classificatory point of view. In *Gerbillus*, *Myoxus*, *Mus barbarus*, *Georychus*, and *Bathyergus* it rises from the second quarter of the fibula; in *Cricetomys*, *Cricetus*, and *Mus rattus* from the third quarter; in *Rhizomys*, *Microtus*, and *Heteromys* from the middle two quarters.

Extensor Brevis Digitorum.—As a rule this muscle has two tendons, one for the second, the other for the third toe; this is the case in *Cricetomys*, *Cricetus*, *Gerbillus*, *Rhizomys*, *Microtus*, *Heteromys*, *Mus barbarus* and *M. rattus*. In *Georychus* the fourth toe has a slip as well. In *Myoxus* and *Bathyergus* I was interested to find a distinct but small tendon to the proximal phalanx of the first toe, these being the only Rodents in which I have ever seen the extensor brevis going to the equivalent of our great toe. In no Rodent, so far as I know, is there ever a tendon to the fifth toe.

Peroneus Longus.—This is always a constant muscle rising from the upper quarter of the fibula, and passing through a groove on the outer side of the external malleolus anterior to the other peroneal tendons. In no animal dissected does it call for any remark.

Peroneus Brevis.—This arises from the middle two quarters of the fibula and passes between the tendons of the peroneus quarti and quinti digiti behind the external malleolus; it then runs above the peroneal spine on the calcaneum, which is usually large, to the base of the fifth metatarsal. It is in many cases a powerful abductor of the little toe.

Peroneus Quarti Digiti.—This muscle is always present, and generally rises just above the fusion of the fibula with the tibia. It has the usual insertion.

Peroneus Quinti Digiti.—This is quite constant and rises just above the last.

Gastrocnemius.—The gastrocnemius differs in no respect from the description given of it in the other Rodents. The three Mole-rats *Rhizomys*, *Georychus*, and *Bathyergus* have no fabellæ developed in the origin of the muscle, while in every other animal examined one was present in each head.

Soleus.—The soleus rises from the back of the head of the fibula and joins the tendo Achillis just below the middle of the leg. In *Myoxus*, however, it rose from the middle of the fibula. The rope-like twisting of the tendo Achillis already referred to [1] is always evident.

[1] Author's paper, Journ. Anat, vol. xxviii. p. 414.

Plantaris.—This has the typical rodent arrangement, the only point of interest being the extent to which the muscular fibres of the flexor brevis digitorum are developed in the sole. In *Gerbillus* three little slips of muscle are alone seen in the intervals between the four tendens where they first separate. In *Microtus* the flexor brevis has no muscular fibres at all, while in *Myoxus* and *Myodes* there are very few. All the other animals examined had well-developed muscular bellies to the flexor brevis.

Popliteus.—The popliteus always rises from the external condyle, and is inserted into the upper part of the internal border of the tibia.

Flexor Longus Hallucis (*Flexor Fibularis*).—This is always a large muscle, rising from both the tibia and fibula and being inserted into the distal phalanges of all the toes.

Flexor Longus Digitorum (*Flexor Tibialis*).—Dobson [1] states that this muscle in the Myomorpha is always separate from the flexor fibularis tendon in the sole. I have, however, met with two remarkable exceptions to this generalization, viz. *Rhizomys* and *Heteromys*. In both of these animals the tendons unite in the sole exactly as they do in the Hystricomorpha. I should mention that this arrangement was present in both the right and left feet. In *Georychus* and *Bathyergus* the muscle is better developed than in most of the Myomorpha, and ends in a bone beneath the base of the first metatarsal which I am inclined to regard as a rudiment of a præhallux. In all the other animals examined the muscle ends chiefly in the fascia of the foot.

Tibialis Posticus.—This is always a small muscle and rises from the upper part of the posterior surface of the tibia below the attachment of the popliteus, and also very often from the back of the head of the fibula. As a rule it has a groove of its own behind the internal malleolus, but in *Myoxus* it shares the groove of the flexor fibularis. It is inserted into the under surface of the navicular, though in *Mus rattus* it goes chiefly to the plantar fascia.

Muscles of the Foot.

Lumbricales.—In *Georychus*, *Bathyergus*, *Rhizomys*, and *Heteromys* only three lumbricales are present. All the other animals dissected have four.

Accessorius.—This muscle is very ill-developed in the Myomorpha. The only animal in which I found it really well marked was in *Bathyergus*, although traces of it could be made out in *Mus rattus*.

Abductor Hallucis.—This is usually present and rises from the navicular in *Cricetomys*, *Rhizomys*, *Mus barbarus*, and *M. rattus*. In *Gerbillus*, *Cricetus*, *Microtus*, *Myoxus*, *Heteromys*, and *Georychus* it came from the internal cuneiform. In *Bathyergus* it was well-marked and rose from the sustenaculum tali of the calcaneum, its proximal part forming the calcaneo-scaphoid ligament.

[1] Journ. Anat. xvii. p. 142.

Adductor Indicis.—The adductor indicis was present in all the animals examined except *Bathyergus*, *Georychus*, and *Heteromys*; in the latter it was replaced by an adductor hallucis, which in the other specimens was wanting, although Windle describes it in *Hydromys*[1].

Prof. Cunningham has pointed out (Journ. of Anat. vol. xiii. p. 11) that the foot of *Bathyergus* is peculiar in the total absence of plantar adducting and dorsal abducting muscles. This statement, which also applies to *Georychus*, I am able to corroborate. The muscle which I have described as abductor hallucis corresponds to Prof. Cunningham's inner head of the flexor brevis hallucis, though in his specimen the origin of the muscle was not so far back as in mine. In no Rodent were any distinct dorsal interosseous muscles found.

Interossei.—There are two interossei, or flexores breves, to each toe inserted into the sesamoid bones beneath the metacarpophalangeal articulation.

Myological Characteristics of the various Families of Myomorpha.

The animals of which the muscles have been described furnish examples of four families of the Myomorpha, namely the *Myoxidæ*, *Muridæ*, *Spalacidæ*, and *Geomyidæ*. Unfortunately the first and last of these are each represented in my dissections by only one individual, and for this reason any generalizations must be made very tentatively. Still it seems worth while making an admittedly imperfect contribution in the hope that it may be added to and corrected whenever fresh material is available.

In the first place, taking *Myoxus dryas* as a type of the *Myoxidæ*, one notices that:—

1. The biceps cubiti is only inserted into the radius.
2. The coraco-brachialis is only represented by the second part.
3. The palmaris longus is absent.
4. The flexor sublimis digitorum is inserted into the fifth digit as well as into the second, third, and fourth.
5. The extensor minimi digiti is only inserted into the fifth digit.
6. The trapezius has the second and third parts fused.
7. The trachelo-mastoid is absent.
8. The rectus abdominis does not decussate at its origin with its fellow of the opposite side.
9. The gracilis is single.
10. The soleus rises from the middle of the fibula instead of from the head of that bone.
11. The tendon of the tibialis posticus lies in the same groove as the flexor fibularis instead of in one of its own.

In the *Geomyidæ*, of which *Heteromys longicaudatus* is the only representative dissected, the following points are of interest:—

1. The digastric approaches the hystricomorphine type.
2. The semitendinosus has only the caudal head present.

[1] P. Z. S. 1887, p. 58.

3. The gracilis is a single muscle.
4. The flexor tibialis joins the flexor fibularis in the sole.
5. There are only three lumbricales in the foot.
6. There is an adductor hallucis instead of an adductor indicis in the foot.

Whether the rectus abdominis decussated with its fellow of the opposite side, could not be determined owing to the large incision which had been made for evisceration before the specimen came into my hands.

The family of the *Muridæ* is represented by accounts of the dissection of nine animals, and I am only able to discover one muscular peculiarity which is common to them all and at the same time distinguishes them from other families,—this is the fact that the rectus abdominis always decussates with the muscle of the opposite side. When one considers what a large and heterogeneous family this is, and that many of the genera included in it are only placed there provisionally, one is not surprised to find that their musculature is not nearly so consistent as it was found to be in the different families of the Hystricomorpha.

To my mind the fact that the latter show definite muscular characteristics which are not found in the former, indicates that the hystricomorphine families consist of animals which are more nearly allied to one another than is the case in the Muridæ: in other words, that the classification of the Hystricomorpha is more successful than that of the Myomorpha.

While speaking of the Muridæ, it is worth noticing that *Cricetus* and *Cricetomys* are the only two of the Myomorpha examined which possess the first part of the coraco-brachialis or rotator humeri muscle. In many particulars, however, they differ from one another.

In the family of the *Spalacidæ* there are records of three animals, *Bathyergus*, *Georychus*, and *Rhizomys*. The following points of resemblance were noticed in this group:—

1. The temporals are large and meet in the middle line of the head.
2. The stylo-hyoid and stylo-glossus are closely blended in *Rhizomys*, while in *Georychus* the stylo-hyoid is absent or completely fused with the other muscle.
3. The pronator quadratus is very feeble.
4. The reflected head of the rectus is ill-marked.
5. The gastrocnemius has no fabellæ in its tendons of origin.
6. There are three lumbricales in the foot.

The following are points of difference between *Rhizomys* on the one hand and *Georychus* and *Bathyergus* on the other:—

1. In *Rhizomys* the digastric has a well-marked central tendon, in *Bathyergus* and *Georychus* there is only an intersection.
2. In *R.* the cleido-mastoid is overlapped by the first part of the trapezius; in *B.* and *G.* it is not.
3. In *B.* and *G.* the scalenus anticus is present. In *R.* it is absent, as it is in all other Myomorpha except *Gerbillus*.

4. In *B.* and *G.* the sterno-scapularis is present. In *R.* it is absent.

5. In *B.* and *G.* the teres major is inserted in front of the latissimus dorsi, in *R.* behind it.

6. The coraco-brachialis is absent in *G.*, small in my specimen of *B.*, absent in Milne-Edwards's specimen. In *R.* the second and third parts are well marked.

7. In *B.* and *G.* the extensor communis digitorum sends no slip to the fifth digit. In *R.* a slip to this digit is present.

8. There is no sesamoid bone in the tendon of the supinator brevis in *B.* and *G.* There is one in *R.*

9. The pair of interosseous muscles which should be inserted into the two sesamoid bones of the fifth digit of the hand are absent in *B.* and *G.* They are present in *R.*

10. The rectus abdominis does not decussate with its fellow of the opposite side in *B.* or *G.*, though it does so in *R.*

11. The gracilis is a single muscle in *R.* It is distinctly double in *B.* and *G.*

12. The flexor tibialis joins the flexor fibularis in the sole of *R.* The two tendons are separate in *B.* and G.

13. The adductor indicis pedis is absent in *G.* and *B.*, present in *R.*

It will thus be seen that, though there are six more or less unimportant points of resemblance between *Rhizomys* on the one hand and *Bathyergus* and *Georychus* on the other, there are 13 points of difference, some of which, such as nos. 3, 4, 10, 12, and 13, I regard as of great importance.

The study of these marked muscular differences in animals whose habits are so much alike, and whose external appearances are so similar, seems to point to one of two conclusions. Either the external appearances are acquired by the animals living under similar conditions while the muscles tell the true tale of their different ancestry, or else the differences in the muscles are of no value for classificatory purposes.

Against the latter conclusion the evidence of the myology of *Bathyergus* and *Georychus* tells strongly; these animals are so alike in their habits, in their osteology, and in their visceral anatomy, that no one doubts that they are closely related; they are also alike in their myology with one or two trifling exceptions. This, however, is only one instance of the close resemblance of the musculature in animals which are for other reasons regarded as akin; and I cannot help thinking that when several important differences occur in the muscles of two animals which otherwise seem closely related, the muscles are trustworthy guides, because, taken as a whole, they are less likely to adapt themselves quickly to changed conditions than are other structures.

With regard to the position of *Rhizomys*, the junction of the two long flexors in the sole has been regarded by Dobson as characteristic of the Hystricomorpha, though I have found it in other animals. As this characteristic is present in *Rhizomys*, it is worth

while noticing that in no other respect does it approach the Hystricomorpha; consequently I think that the study of the muscles bears out the suggestion of Winge[1] that *Rhizomys* is distinct from the Bathyerginæ, and that it should be placed among the Muridæ, which it resembles in the only common point which this family has—the decussation of the rectus.

Winge[1] also suggests that *Bathyergus* is closely allied to the Hystricidæ. The following points in its myology show a divergence from the myomorphine and an approach to the hystricomorphine arrangement:—

1. The scalenus anticus is present and rises from the basi-occipital.

2. The scapulo-clavicularis is present, as in all Hystricomorpha, while in no myomorphine rodent was it found.

These two points alone would not of course justify one in separating the Bathyerginæ from the Myomorpha, but they show an approach to the hystricomorphine type which is suggestive.

The Position of the Dipodidæ.

A review of the muscles of Rodents would be incomplete without considering whether they lend any assistance towards determining the vexed question of the position of the Jerboas. In my former contribution I described their muscles with those of the Hystricomorpha. Now that the muscles of the Myomorpha have been worked out, a comparison can be made between them.

In the following points the Dipodidæ resemble the Hystricomorpha:—

1. The large size of the anterior deep part of the masseter passing through the infraorbital foramen.

2. The presence of a scalenus anticus rising from the basi-occipital.

3. The presence of only one head of the biceps cubiti.

4. The non-decussation of the rectus abdominis at its origin with the muscle of the opposite side.

5. The union of the tendons of the flexor tibialis and fibularis in the sole.

The first point is only one of degree since the Myomorpha show a small piece of the masseter passing through the infraorbital foramen.

The second has been found in *Myoxus* among the Myomorpha, as well as in *Bathyergus* and *Georychus*, whose position is not quite certain.

The third point is certainly in favour of hystricomorphine tendencies, as I have not yet found any myomorphine rodent without two heads to the biceps cubiti.

The fourth point, the decussation of the rectus, is not always found in the Myomorpha, while it sometimes occurs, as in the Octodontidæ, among the Hystricomorpha.

[1] E Museo Lundii, 1888, p. 109.

The union of the tendons in the sole has been already alluded to as not being entirely confined to the Hystricomorpha.

In the following points the Dipodidæ resemble the Myomorpha:—

1. The sciuromorphine arrangement of the digastric.
2. The presence of a transverse mandibular muscle.
3. The absence of the scapulo-clavicularis.
4. The presence of the omo-hyoid.
5. The absence of the splenius colli.
6. The origin of the levator claviculæ (acromio-trachelian) from the atlas.

The first three of these are very important and constant points, the latter three are sometimes noted in the Hystricomorpha.

On the whole I think that the myological points in favour of myomorphine tendencies for the Dipodidæ are far stronger than those in favour of hystricomorphine.

General Summary of Muscles of Rodents.

In order to complete my paper I propose to give a series of lists of the different points in which the four suborders of Rodents differ from and resemble one another, though the following pages are only tentative, and liable to require rearrangement as further material is added. They may, however, prove useful in directing the attention of future observers to the muscles deserving of special notice from a classificatory point of view, and they may also be of service in showing the muscles that are constant in Rodents nearly related, whatever their mode of life may be, and that may turn out to be equally constant in nearly related groups belonging to other orders.

In a former contribution[1] the differences between the Hystricomorpha and Sciuromorpha are summarized.

Differences between the Myomorpha and Hystricomorpha.

1. The part of the masseter which passes through the infra-orbital foramen is usually small in the Myomorpha, large in the Hystricomorpha.
2. The Myomorpha have the sciuromorphine arrangement of the digastric.
3. The transverse mandibular muscle is present in the Myomorpha, absent in the Hystricomorpha.
4. The omo-hyoid muscle is always present in the Myomorpha, and may be present or absent in the Hystricomorpha.
5. The acromio-trachelian (levator claviculæ) always rises from the arch of the atlas in the Myomorpha. In the Hystricomorpha it sometimes rises from the basioccipital.
6. The scalenus anticus is usually absent in the Myomorpha, usually present in the Hystricomorpha.

[1] P. Z. S. 1894, p. 294.

7. The clavículo-scapularis is absent in the Myomorpha, present in the Hystricomorpha.

8. In the Myomorpha the three parts of the deltoid lie close together. In the Hystricomorpha they are separated by distinct intervals.

9. The biceps cubiti has two heads in the Myomorpha. In the Hystricomorpha there may be one or two.

10. The Myomorpha seldom have the first part of the coraco-brachialis, in the Hystricomorpha it is often present.

11. The splenius colli is never found in the Myomorpha, in the Hystricomorpha it is sometimes seen.

12. The two parts of the biceps femoris are usually distinct in the Hystricomorpha. In the Myomorpha they are seldom separable.

13. In the Myomorpha the flexor tibialis and flexor fibularis do not usually join in the sole. In the Hystricomorpha they are always united.

14. In the Myomorpha the accessorius is absent or very ill-developed. In the Hystricomorpha it is present and well marked.

Differences between the Myomorpha and the Sciuromorpha.

1. The three parts of the temporal muscle are more closely fused in the Myomorpha than in the Sciuromorpha.

2. A small part of the masseter passes through the infraorbital foramen in the Myomorpha. No part passes through in the Sciuromorpha.

3. The three parts of the deltoid are more closely fused in the Myomorpha than in the Sciuromorpha.

4. In the Myomorpha a rotator humeri is only found in the Cricetinæ. In the Sciuromorpha it is always present.

5. In the Myomorpha the flexor sublimis digitorum sends no slip to the fifth digit. In the Sciuromorpha this slip is present.

6. The supinator longus is absent in the Myomorpha, but is present in the Sciuromorpha except *Castor*[1].

7. The extensor longus digitorum always sends a tendon to the fifth digit in the Sciuromorpha; this tendon is often absent in the Myomorpha.

8. The rectus abdominis often decussates at its origin with its fellow in the Myomorpha. There is no decussation in the Sciuromorpha.

9. The quadratus femoris is triangular in the Myomorpha, quadrilateral in the Sciuromorpha.

10. The supracondylar slip of the semi-membranosus always rises from the tuber ischii and is closely connected to the adductors in the Sciuromorpha. In the Myomorpha it may rise from the tuber or caudal vertebræ and is distinct from the adductor mass.

[1] Macalister describes an exceedingly feeble supinator longus in the Beaver ('Morphology of Vertebrate Animals,' p. 289).

11. The gracilis is usually double in the Myomorpha, single in the Sciuromorpha.

12. The accessorius is usually absent in the Myomorpha, always present in the Sciuromorpha.

With a view to comparing the myology of the Lagomorpha with the other suborders, I dissected the muscles of a Hare and a Rabbit, but have refrained from enlarging this paper with a detailed description of these muscles because they have already been described by other authors.

Differences between the Myomorpha and the Lagomorpha.

1. In the Myomorpha the different parts of the temporal are closely connected. In the Lagomorpha the orbital part is large and much separated from the rest.

2. In the Myomorpha the anterior deep part of the masseter passes through the infraorbital foramen. In the Lagomorpha there is no anterior deep part.

3. The posterior belly of the digastric is well marked in the Myomorpha, in the Lagomorpha it is only present as a narrow tendon.

4. The transverse mandibular muscle is present in the Myomorpha, absent in the Lagomorpha.

5. The omo-hyoid is present in the Myomorpha, absent in the Lagomorpha.

6. The acromio-trachelian (levator claviculæ) rises from the arch of the atlas in the Myomorpha. In the Lagomorpha it rises from the basioccipital and bifurcates below, one part going to the metacromion, the other to the clavicle and deltoid.

7. The scalenus anticus is sometimes present in the Myomorpha but absent in the Lagomorpha.

8. The scapulo-clavicularis is absent in the Myomorpha, except the Bathyerginæ. It is present in the Lagomorpha.

9. The three parts of the deltoid are fused in the Myomorpha, separate in the Lagomorpha.

10. The biceps cubiti has two heads in the Myomorpha, one in the Lagomorpha.

11. Among the Myomorpha the rotator humeri is only present in the Cricetinæ. In the Lagomorpha it is present in both rabbit and hare.

12. The pronator quadratus is present in the Myomorpha, absent in the Lagomorpha.

13. The clavo-cucullaris part of the trapezius is generally present in the Myomorpha, absent in the Lagomorpha.

14. The splenius colli is absent in the Myomorpha, present in the Lagomorpha.

15. The rectus abdominis frequently decussates with its fellow of the opposite side in the Myomorpha. In the Lagomorpha there is no decussation and the lineæ transversæ are much better marked.

16. The gracilis is usually a double muscle in the Myomorpha, single in the Lagomorpha.

The distinctions above given are possibly more numerous than they would be if the opportunity of dissecting a Pika (*Lagomys*) had presented itself.

To merely point out the differences between the various suborders does not give a just idea of their muscular characteristics. It is necessary also to lay stress on the chief points in which one resembles another and differs from the rest.

In the first place the Myomorpha resemble the Hystricomorpha and differ from both the other suborders in the following points:—

1. A slip of the masseter passes through the infraorbital foramen.
2. The three parts of the temporal are more closely fused.
3. The rectus abdominis often decussates at its origin.
4. The gracilis is usually double.
5. The supracondylar slip of the semimembranosus often comes from the caudal vertebræ.

The Myomorpha resemble the Sciuromorpha and differ from the other two suborders in the following points:—

1. The sciuromorphine type of the digastric.
2. The presence of the transverse mandibular muscle.
3. The constant presence of the omo-hyoid.
4. The acromio-trachelian (levator claviculæ) always rising from the atlas.
5. The absence of the scalenus anticus in the Sciuromorpha and in the Myomorpha except the Bathyerginæ and *Gerbillus*.
6. The absence of the scapulo-clavicularis in both, with the exception of the Bathyerginæ.
7. The presence of the two heads to the biceps cubiti.
8. The presence of the clavo-cucullaris part of the trapezius.
9. The absence of the splenius colli.
10. The presence of ischial and caudal heads to the biceps femoris, the latter being often more or less blended with the gluteus maximus.
11. The fact that the flexor tibialis (flexor longus digitorum) does not join the flexor fibularis (flexor longus hallucis), except in *Rhizomys*, *Heteromys*, and partly in *Pteromys*.

I have been unable to find any point of importance in which the Myomorpha resemble the Lagomorpha and differ from the other two suborders.

The Hystricomorpha resemble the Lagomorpha and differ from the other two suborders in the following points:—

1. The presence of the scapulo-clavicularis.
2. The omo-hyoid is often absent in the Hystricomorpha, always in the Lagomorpha.

3. The absence of the transverse mandibular muscle.
4. The frequent origin of the acromio-trachelian (levator claviculæ) from the basioccipital.
5. The usual presence of only one head of the biceps cubiti.
6. The occasional presence of the splenius colli in the Hystricomorpha and its constant presence in the Lagomorpha.
7. The basioccipital origin of the scalenus anticus when that muscle is present.

The Sciuromorpha resemble the Lagomorpha and differ from the other two suborders in the following points:—
1. The rotator humeri portion of the coraco-brachialis is always present.
2. The supracondylar slip of the semimembranosus rises from the tuber ischii in both, but while it is closely connected to the adductor mass in the Sciuromorpha, it is separate from it and adherent to the rest of the semimembranosus in the Lagomorpha.

On looking through these lists one cannot help being struck by the frequency with which certain muscles, such as the omo-hyoid, the scapulo-clavicularis, the acromio-trachelian, the scalenus anticus, the splenius colli, the trachelo-mastoid, and the rectus abdominis, occur again and again. It is chiefly by various combinations of these muscles aided by a few others, such as the transverse-mandibular, masseter, digastric, biceps, coraco-brachialis, &c., that the affinities between animals belonging to the same group are marked; and it seems to me that one would be justified in saying that, in Rodents at all events, the muscles of the trunk and neck are the most valuable for classificatory purposes. It may be urged that all these muscles are liable to individual variation; and this of course is probably true, though I am inclined to think that individual variations are far less frequent in Rodents than in Man; still if five or six of these muscles are taken, the risk of more than one being abnormal must be very slight indeed. As an instance of this the case of the Jerboa might be cited. In all the Hystricomorpha examined a scapulo-clavicularis had been found, but in the Jerboa it was absent. At that time I looked upon the animal, with Dobson, as hystricomorphine, and I regarded the absence of the muscle as an individual variation; as the dissection proceeded I found other points which were different to anything seen in the Hystricomorpha; later on I was lucky enough to get two more Jerboas of different species to the first one, and in both of these the scapulo-clavicularis was wanting also. Without the confirmatory testimony of the other muscles, the absence of the scapulo-clavicularis would probably have been passed over as of little importance. If the long flexors of the foot are considered, it will be found that they are not so reliable as the muscle just quoted. Dobson says that these long flexors unite in the Hystricomorpha but not in the other suborders; I have found, however, three animals—*Rhizomys*, *Heteromys*, and *Pteromys*—which have no

other affinities with the Hystricomorpha, but in which the union took place.

Other facts which may perhaps be of interest to the systematist are borne out by the foregoing lists. It is quite evident that the myology of the Myomorpha resembles that of the Sciuromorpha much more closely than that of the Hystricomorpha. The Lagomorpha, on the other hand, in their myology are much more closely allied to the Hystricomorpha than to the Myomorpha or Sciuromorpha, and of the two latter are nearest the Sciuromorpha. These conclusions I believe are already recognized by systematists from a study of other parts than muscles; and the fact that myology bears out these conclusions is to my mind an important plea for the value of the study of muscles as a help to settling the position of animals.

The results of this and the preceding paper may be briefly summed up in the following propositions:—

1. That the Myomorpha and Sciuromorpha approach one another in their myology.
2. That the Hystricomorpha similarly approach the Lagomorpha.
3. That the Bathyerginæ in many respects resemble the Hystricomorpha.
4. That *Rhizomys* more closely resembles the Muridæ than the Bathyerginæ.
5. That the Dipodidæ are more nearly allied to the Myomorpha than to the Hystricomorpha.
6. That in Rodents certain muscles are valuable for classificatory purposes and, if several are taken, are not likely to mislead.
7. That the muscles of the trunk, neck, and shoulder-girdle are the most reliable.

5. Description of a new Species of Antelope from East Africa. By Oscar Neumann [1].

[Received January 1, 1896.]

Among the animals collected during my expedition to East and Central Africa, in 1892–95, there are examples of an Antelope from Uganda, Ussoga, and Kavirondo, belonging to the genus *Adenota*, Gray. This Antelope seemed to me to be different from *Adenota kob*, with which it had hitherto been united. Not having enough material of the true West-African *Adenota kob* in Berlin, I took two horns and one skin of this species with me to compare them in Paris with Buffon's type and also with specimens in London. In both places I found my opinion confirmed; I also found that both Mr. Thomas and M. de Poussarges had independently arrived at the same conclusion—thanks to additional material brought by Mr. Dècle from Uganda, and by Captain Lugard from the Niger. I propose to name this species, in honour of Mr. Thomas,

[1] Communicated by the Secretary.